

## SUBSEA WIRELINE LUBRICATOR

### FIELD OF THE INVENTION

The present invention relates to a pressure control device. More particularly the invention relates to a compact pressure control device for use in a subsea lubricator stack.

### BACKGROUND OF THE INVENTION

5 When developing subsea oil and gas wells there are stringent demands to the control and containment of the well during all aspects of the work, be it drilling, production or later intervention. The needs for control of well pressure have lead to requirements for safe barriers in the well and/or above ground, both during  
10 production and during intervention work.

During the lifetime of the well various types of work may be carried out to enhance production or to measure conditions in the well. Well intervention may be difficult, as existing barriers have to be removed to gain entry into the well. There are in most countries strict rules regarding the size and number of barriers needed to keep  
15 control of the well during intervention. To gain access to a living well a blowout preventer, containing a number of valves, must be connected to the well before the well barriers can be opened. In addition, a number of pressure containment devices ensure control over the well during the work.

20 One of the methods for gaining entry into a live well is by using a lubricator. This employs a tool attached to the end of a wire or cable and inserted into the well. This equipment includes means whereby grease can be injected under pressure to seal around and lubricate the wire or cable during rising or lowering of the tool, hence the name lubricator.

25 Lubricators are in use both on surface and on subsea wells. US Patent no. 4,993,492 shows an example of a surface lubricator, while US Patent No. 3,638,722 and International Patent Application no. WO 0125593 shows examples of subsea lubricators. In for example WO 0125593 there is shown a subsea lubricator  
30 consisting of the afore-mentioned blowout preventer, called a Lower Intervention Package (LIP), a tool housing (or lubricator pipe), and a pressure control head which includes a grease injector assembly. When lowering a tool into the well using this equipment, the wire or cable is inserted through the pressure control head and the tool attached to the end of the wire. Then the whole assembly is lowered to the  
35 seabed and the tool guided into the tool housing while the LIP valves and Christmas tree valves are closed. Then the grease injector is closed around the wire above the

tool. The LIP valves and Christmas tree master valve can now be opened so that the tool can be lowered into the well.

5 The tool housing must be of a length capable of holding the full length of the tool, and is can be up to 30 meters long. The whole lubricator assembly may be up to 50 meters long.

10 To ensure a greater degree of safety, an additional blow out preventer is mounted on top of the tool housing. One common type is a shear/blind ram in combination with one (or two) wireline rams. The shear ram is used to cut the wire or cable in an emergency. The wireline ram(s) are designed to grip and hold the wire and include facilities for grease injection, see for example US 4,938,290. The main disadvantage with these is their large size and weight. Its weight mounted on top of a (up to) 30 meters column, exerts a large bending moment on the lubricator and necessitates  
15 stronger (and therefore heavier) tool housing and connectors.

A stuffing box is also normally included in a lubricator assembly located above the grease injector. The stuffing box is intended to grip and hold the wire or cable in the event of gas leaking past the grease injector. Examples of known stuffing boxes are  
20 shown in GB 2,214,954 and US 2,943,682. In US 5,863,022, a stripper/packer including a split bonnet is shown. The packer also serves as a blowout preventer. The packer can be axially activated to achieve a radial sealing, and the function of the packer is similar to a stuffing box. The present invention can be used together with a packer of this type.

25 To reduce some of this weight the lubricator described in WO 0125593, uses only the shear/blind ram in conjunction with a second high pressure stuffing box with grease injection, the stuffing box being a replacement for the wireline ram. However, a stuffing box in this position will have well pressure acting on the lower  
30 surface of the rubber cylinder, thereby adding to the forces keeping the rubber in compression. There are also higher frictional forces. This makes it difficult to control the stuffing box properly. One consequence has been that it has proved difficult to reopen the stuffing box, forcing the operator to cut the wire and retrieve the whole lubricator to the surface. This can be a costly operation.

35 In US 6,394,460, a one-piece ram element block for wireline blowout preventers is shown. The ram element block is a part of a BOP housing with a generally vertically oriented bore for a wireline. The BOP housing defines a pair of opposed ram element bores wherein linearly movable ram elements are located. Here, high  
40 pressure grease is injected into the flow passage between the upper and lower ram elements, thereby effecting a proper wireline seal when the rams are actuated to

their closed positions. The ram elements are not located in separate bores and can not be independently controlled.

5 An object of the present invention is therefore to produce a pressure containment device in place of the stuffing box which can be positively and exactly balanced and will give a better control over the gripping forces than existing stuffing boxes. As the shear/blind ram function is also built into the device it will eliminate the need for the upper blowout preventer. It is small and compact and will therefore reduce the overall bending moments on the lubricator. This in turn makes it possible to  
10 reduce the strength and size of the tool housing and connectors.

The present invention utilises positively closing and opening rams to grip and hold the cable or wire. It also includes a shear/blind ram so that it will cut the wire or cable in a emergency. Because the unit is located in the pressure control head, e.g.  
15 above the tool housing, the internal size can be related to the wire diameter and not, as in the present, the tool diameter.

#### SUMMARY OF THE INVENTION

The invention thus provides for pressure containment device comprising a main housing, first longitudinal through bore arranged to receive a wire or cable slidingly  
20 therethrough, at least two spaced apart transversal through bores intersecting the main bore, each transversal bore carrying a pair of opposing rams

The bore of the ram is preferably lined with a cylindrical sleeve, enabling several sizes of wire to be used by only changing the sleeves.  
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The invention will in the following be explained with a preferred embodiment which is one not limiting example of how the invention may be employed, with reference to the drawings.

#### DESCRIPTION OF THE DRAWINGS

30 Fig. 1 shows a lubricator of prior art type.  
Fig. 2 shows the invention used in the pressure control head  
Fig. 3 shows the grease injector  
Fig. 4 is a detail of the grease injector.  
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#### DESCRIPTION OF THE PREFERRED EMBODIMENT

In fig. 1 is shown a prior art type subsea lubricator 1. This consists of blowout preventer 2 (LIP). Attached to the LIP is an Emergency Disconnect Package (EQDP) 3. A lubricator tool housing 4 is connected to the EQDP. The tool housing is in the form of a pipe of a length that will contain a tool before lowering into the well. A pressure control head 5 is connected to the tool housing. The pressure control head includes grease injectors 6, a line wiper 7, and a stuffing box (not shown). An upper blowout preventer 8 is located on top of the tool housing 4.

When used on a surface well, the EQDP is omitted.

Fig. 2 shows the pressure control head assembly 20 according to the invention. This consists of, from bottom to top, a connector 21 for coupling to the tool housing, a tool catcher unit 22, the pressure control device 30 (that will be described in more detail later), first 23 and second 24 grease inlets, a grease return 25 and a combined upper stuffing box and line wiper 26. The numerals 27-29 depicts grease tubes. The upper stuffing box and line wiper 26 can, as an example, be of the type shown in US 5,863,022.

During intervention work this unit acts as the primary seal barrier preventing hydrocarbons from escaping into the environment. Grease is injected under pressure through inlets 23 and 24 travels up along grease tubes 27-29, sealing and lubricating the wire and returned through grease outlet 25. The stuffing box is only used when there is a need to clamp and hold the wire securely, as can happen if hydrocarbons leak past the grease tubes. The tool catcher unit holds the tool during raising and lowering from the surface to the seabed.

In fig. 3 is shown the pressure containment device according to the invention. The unit consists of a solid housing 31, in the form of a rectangular solid metal block. The housing may have coupling parts such as flanges (not shown) at each end for connecting the housing with the rest of the pressure control head assembly. A main bore 32 extends through the length of the housing. When assembled into the pressure control head the main bore is aligned with the bore above and below to give a fluid path through the lubricator.

Auxiliary bores 33, 34, 35, 36 and 37 extends transversally through the housing 31. The auxiliary bores intersect the main bore 31. As shown bores 33 - 37 may be located in the same vertical plane as the axis of main bore 31. Grease supply bores 38 and 39 also located in the same plane extends from the side but ending in ports (only port 40 is shown) in main bore 31. As seen on fig. 3, bore 38 is located between bores 33 and 34 while bore 39 is located between bores 35 and 36.

As an alternative, the bores can be staggered around the sides of main housing 31, for example can by bore be located perpendicular to the next bore, or the bores can be distributed stepped from each other.

5 In each bore 33 – 36 a pair of opposing rams 41, 42 (fig. 4) are arranged to move towards each other as is well known. Each ram consists of a main cylindrical part 43 with a sliding fit within its bore. A rod 44 attached to cylindrical part 43 is intended to be connected to an actuator (not shown) that can be bolted onto the housing. A cylindrical body 45 of an elastic material such as rubber is fixed to the  
10 front of part 43 as shown in fig. 4. Rubber body 45 preferably has an outer diameter so that it will seal against its bore. Rubber body 45 has a front surface 46 with a vertical slot 47. When the two rams are in their fully closed position, surfaces 46 will abut and seal against each other except for the slots 47 which will define a circular opening for the passage of wire or cable.

15 In bore 37 there is located a shear/blind ram for cutting wire or cable as is well known in the art. Bores 38, 39 are connected to a pump (not shown) for supplying grease under pressure to bore 31.

20 Main bore 31 has an inner sleeve lining. As can be seen from fig 3 and 4 the sleeve consists of a number of smaller sleeves. Upper sleeve 51 extends from top of housing 31 to first ram bore 33. First intermediate sleeve 52 extends between first 33 and second 34 ram bores. Sleeve 52 may be in two parts separated by a gap 54 located in the area of grease injection bore 38, as shown on fig. 4, or alternatively  
25 may have a port oriented in line with grease through bore 38. Second intermediate sleeve 53 extends between second 34 and third 35 ram bores. Third intermediate sleeve (not shown) between ram bores 35 and 36 is identical to sleeve 52 while fourth intermediate sleeve (not shown) between ram bores 36 and 37 is identical to sleeve 53 and lower sleeve (not shown) is identical to upper sleeve 51.

30 Each sleeve is a sliding fit within main bore 31; that is, the sleeves are position in bore 31 with a very small clearance. When mounted each sleeve is oriented in the correct angular position and fixed in place, for example with screws or latches. Moreover, each sleeve has an inner diameter corresponding to the outer diameter of  
35 the wire or cable in use so that the wire has a small clearance within the sleeves.

The sleeves have two functions. They are exchangeable and can therefore be sized to fit the size of the wire or cable in use to obtain the desired tight fit. Therefore, when using another size cable or wire, the sleeves can easily and quickly be  
40 exchanged with sleeves tailored to the wire size. The sleeves will also prevent the rubber on the rams from extruding into main bore 31 when subjected to pressure when grease is pumped into main bore 31.

The rams 33-35, and the shear rams 36 and 37, are actuated by means of controllable actuating means (not shown). The actuating means are preferably hydraulically or mechanically driven, where the force from the controllable actuating means on the rams is controllable. Moreover, the force from the controllable actuating means can be controlled independently for each of the rams. A detecting device, such as a gas detector, television camera etc, is preferably used to detect the conditions in the well. The controllable actuating means can be controlled based on the detected condition.

In use, rams 33-35 will be actuated to close around the wire or cable to hold it securely. At the same time, grease is injected through grease injection ports 38, 39 by means of grease injection means, to seal between wire and sleeve. The grease injection means is controlling the pressure of the injected grease.

If necessary, shear ram 37 will be activated to shear off wire, allowing the main valve in the LIP and the Christmas tree master valve to be closed.

The use of rams allow for a precise control of the tightness around the wire. If so desired, the rams can be positioned with slightly reduced pressure to allow the wire to be drawn through the rams while maintaining control over grease pressure. This allows the tool to be moved to a safer location, for example into the tool housing while still maintaining control of the well. The continuous injection of grease under high pressure makes it possible to control and contain the well pressure.

In an emergency the shear ram will be activated to cut the wire or cable. This will cause the tool to fall into the well and allow the lubricator to be disconnected and removed.